Safety in Spaceflight: Recognizing Narrow Margins
You are here

The really BIG Picture
What keeps a Great Team safe?

- Processes
- Procedures
- Tools
- Most important: People!
Life in a Pressure Vessel...
Forget your margins:
Kill you or your company
Space: can you find the 14 pressure vessels?
CI: The recognition that the margin between success and failure is very narrow; test and train to maximum efficiency.

- Details missed CAN kill you (kill your brand)
- Question EVERYTHING
- Act like everyone has your life (career) in their hands
- Plan, brief, execute, debrief (PBED), REPLAN…
- Communicate objectives and expectations
Col John Boyd’s “OODA Loop”
First Crew:

- **STS-89**: Culture challenges
- **STS-104**:
- **STS-117**:
Three Things:
• Do you have a plan?
• Is it working?
• Are you ahead or behind?

Fourth thing:
• What would you do differently?
• PBED!
Train like you fly, fly like you train!
Second Crew:

- **STS-89:**
- **STS-104:** Overachievers
- **STS-117:**
Your life depends on your team!
Each task evaluated for safety and efficiency

Each procedure a series of tasks
MMOD – Impact (literally)
Third Crew:

- STS-89:
- STS-104:
- STS-117: Leaders All – Team Challenges
Install the S3-S4 Truss and Solar arrays
- Faced lots of unanticipated challenges
220 orbits, 5.81 million miles in 13 days, 20 hrs, 12 min. 44 sec.
Three Different Teams: All Successful!

• The Mission is CRITICAL
  • Each has a role required for success
• Fun is contagious and cements the team
  • STS-104, Southwest Airlines
• Train like you fly; fly like you train
  • Make CI part of your training and mission
• Question EVERYTHING
  • If getting relaxed, start checking details
• Continuous Improvement is a lifestyle…
  • CI rests on a foundation of communication
Simple Rules for Great Teams

• Know your team
• Know your mission
• Work together for success
• Protect your Margins
• Enjoy the ride!
Space Shuttle *Columbia* accident:

Teamwork and Communications Failure Case
The bad news: a pound and a half of foam hitting the wing…

Bipod foam impacting left wing

The really bad news: this foam had been shed before and we knew it…
What happened?
First job: find our crew

Second job: find the fault
STS-112 Bipod Foam Loss
Mach no. = 0.75
MET = 35 seconds
Altitude = 12,000 ft
Debris mass = 0.288 lbs.

STS-107 ET208 Video Fields

16:15:40:21.695 to .862 UTC
Unable to track debris in two fields (.778 & .795)
Orbiter Wing Leading Edge Temperature Distribution

Approximate Plug Location

STS 107
\[ t_{El} = 921.44 \text{ sec} \]
\[ M_\infty = 17.88 \]
\[ \alpha = 39.02^\circ \]
Repair site CFD Solutions
Mach 18 Temperatures

*DPLR Alternate Physical Model*

Baseline

Distorted Airflow
Kirtland Photo Seems to Show a Disturbed Flow Field in Front of the Left Hand Wing
What happened on the day of launch?

RCC Panel 6 775 fps, 1.5 lbs.-m. Test Video
How did it happen?
More difficult question...
Columbia reconstruction: not the usual a/c case.
How to begin the failure analysis
Change the decision-making culture

• Move away from the “prove it isn’t safe” to back to the “prove it’s safe”
  – We operate at the ragged edge of physics
  – Every time we forgot this we killed someone
• Overused term: Empower…but it is applicable
  – Make sure everyone is heard
  – Don’t let the desire to “check the box” drive your decision
• Remember that schedules are only a guideline
• Listen to your troops!!
• *Listen to your troops!!*
Apollo 1
January, 1967
Basics of a good Team:
✓ Belief
✓ Trust
✓ Respect
✓ COMMUNICATION!

INTEGRITY!